The hearing, the mapping, and the Web: Investigating emerging online sound mapping practices*

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Abstract: Recent years have seen the emergence of sound mapping, through which users can share their recordings of sounds via online mapping platforms. These practices are enabled by an array of spatial and digital technologies that also facilitate the growth of the so-called volunteered geographic information (VGI) regarding contributions from users without training in conventional GIS or cartography. In the growing body of work on VGI, however, not much attention has been given to the emergence of sound maps as part of the VGI constructions. Meanwhile, research in soundscape has not addressed the aspect of crowd-sourcing or user-generated contributions facilitated by new information and communication technologies. This article seeks to bridge this gap. It draws upon important insights from critical GIS research into investigating VGI as visual practices, while it is also informed by three areas of soundscape research including mapping soundscapes, tracing the production of soundscapes and exploring embodied experiences with soundscapes. Through an empirical case in China, this article suggests a two-level analytical framework: investigating in what ways such crowd-sourced sound maps emerge and interpreting these sounds on the shared platform. In so doing, this study calls for more engagement with the multi-modality aspect of visuality in mappings, which in turn may have implications for landscape design and planning. In this way, it seeks to enrich the discussion on critical visualization.

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1. Introduction

Recently, a range of so-called sound maps have emerged, through which users may share their recordings of sounds of particular places online (for example, the Soundcities project (http://www.soundcities.com/) and the Toronto Sound Map (http://torontosoundmap.com/)). These sound maps can be seen as part of the emergence of an array of geospatial technologies facilitated by Web 2.0 technologies and mobile devices that have resulted in the explosive growth of user-generated geographic information. This phenomenon is often referred to as volunteered geographic information (VGI) (Goodchild, 2007). One of these sound maps is the China Sound Map (CSM) (http://soundmapping.cn/). Initiated by two artists, the CSM has more than five hundred contributions uploaded by registered users. The coverage of the contents in these contributions is vast, in which examples include sounds of rainfall, conversations on the bus, and a few seemingly random songs. Users' interests in this map have been growing, partly reflected in the growing membership of its interest group on Douban, a Chinese social media website. While this is not a dominant way of mapping in China, how might these sound mapping practices help us illustrate the power of mapping with auditory experiences pinned in particular places? For example, what kinds of sound might be captured and displayed on the map? What can these auditory narrations tell us about the space/place and those particular moments recorded through this way of mapping? Similar questions can be asked regarding other cases of sound maps elsewhere.

However, little attention has been paid to this new kind of mapping practice that embodies non-visual sensory aspects including auditory experiences through user-generated contributions. Given the growing possibilities of capturing, illustrating, and representing everyday life through

VGI including sound maps, it is necessary to discuss how an important element of everyday setting, the sound environment, might play a role in these mapping practices. I thus seek to bridge this gap and explore how this way of mapping emerges and its possible implications through an investigation of the CSM initiative in China.

Drawing upon insights from critical GIS and VGI research and soundscape research, I intend to contribute to the discussion on critical visualization by calling for more attention to the intersection between cartographic representation and auditory narratives. In particular, there have been fruitful discussions in critical GIS research that examine VGI as *visual* practices, through which a number of meanings can be registered, for example, representation of everyday life and activism ranging from mobilizing efforts to enhancing awareness (cf. Elwood, 2011). The focus has been to illustrate how these visual practices may deviate from traditional mapping practices and GIS representations. With the increasing availability of these geospatial technologies to a much wider range of users, discussions have also addressed the intersection of VGI and public participation GIS (PPGIS) (e.g., Tulloch, 2008) concerning the potential of VGI in encouraging greater public participation through using geospatial technologies. While the existing literature has acknowledged the multi-media characteristic of VGI, not much attention has been given to the auditory aspect of VGI production and construction. I seek to extend this line of investigation of VGI as visual practices to incorporate a more expanded discussion on the notion of multi-modality of visuality (Degen, DeSilvey, & Rose, 2008; Merriman, Revill, Cresswell, Lorimer, Matless, Rose, & Wylie, 2008) in urban studies and landscapes to unpack the complexities of sound mapping practices.

On the other hand, soundscape research has provided rich insights into the auditory experiences and representations. Soundscape is a notion that "accounts for the relationship between the individual experience and subjectivity with a physical and a socio-cultural context" (Raimbault and Dubois, 2005, p.310). From the vast body of work on soundscape, I suggest that three areas of research are helpful to explore the heterogeneous, crowd-sourced sound maps, including efforts to map sounds (e.g., Balaÿ, 2004), trace the production of soundscapes (Thompson, 2004), and explore the embodied experiences through a phenomenological approach (e.g. Revill 2014).

Using the CSM as an illustrative case, I will discuss how particular technological and social conditions have shaped the construction of the CSM. While one might need a certain level of coding experience to set up the CSM initially, this platform provides a rather straightforward channel for the users to engage with and share sounds they encountered. The commitment from certain artists is key to constructing the CSM. Second, I will highlight the three broad themes emerged from the CSM construction and usage. These themes range from recording everyday sound environments for reflection to recording particular moments and events and to recording more explicit political statements. With the possibilities of encountering various sounds from different recorders, listeners may create their own space-time imaginations through these sounds embedded in a particular location pinned on the map. This process resonates with the notion that mapping spaces are always in the making and illustrates the multi-sensory appreciations of these spaces, which are intersected with code, space and time, suggesting the importance of engaging with multi-modality of visuality in VGI.

In what follows, sections two and three focus on the review of relevant theoretical strands. In section four, the methods and data sources are discussed, followed by section five on the case study of the CSM project, with the last section summarizing and concluding the article. This article concludes by calling for further research on the mode of sound mapping as a form of knowledge production and practice mediated by auditory experiences, mapping practices, and digital transformations. Although this article is limited in the scope and it may pose more questions than answers, it may provoke new and different hearings, readings and imaginaries of landscapes as well as new openings for critical visualization. These crowd-sourced sound maps may provide a complementary source of documenting and illustrating the sound environment for landscape design and planning. They may also help to question and contest dominant discourses of representing and imagining particular places and time. Following Voegelin (2014), the soundscape, constituted through sound maps, may give us "access to what is there if we look past the object into the complex plurality of its production", and it may show us "the world through relationships and processes, reminding us of the ideological and aesthetic conditions that determines any sensory engagement" (p.10).

2. VGI as visual practices

The recent explosive growth of user-generated geographic information since the mid-2000s has drawn significant attention from GIS scholars and geographers. This growth of spatial data has been facilitated by Web 2.0 technologies and location-aware devices (Goodchild, 2007; Haklay, Singleton, & Parker, 2008; Sui, Goodchild, & Elwood, 2012). The notion of VGI has been used to describe the emergence of such information produced through conscious efforts (Elwood, 2010; Goodchild, 2007), examples of which include data created through WikiMapia,

OpenStreetMap, Google Maps, etc. Other related terms include neogeography (Tuner, 2006) and the geoweb (Scharl and Tochtermann, 2007). Compared to conventional GIS and cartographic practices, these user-generated mapping practices tend to be more mobile and individualized, which are often accompanied with multi-media representations of spatial information (Elwood, 2009). They have often revolved around everyday practices (Dodge and Kitchin, 2007; Elwood, 2010; Lin, 2013a).

What is particularly relevant to my study here is the strand of work that views VGI as visual practices (Elwood, 2011), which seeks to reveal how VGI is collected, constructed, shared, and utilized as well as work on ways of creative engagements with these geospatial technologies and data, underlining the questions of representation, power, knowledge and equality. These studies build upon research in critical GIS and cartography that views maps and map making as social processes and practices (e.g., Del Casino and Hanna, 2006). In these discussions, mappings and cartographic representation embody and are shaped by power relations. On the other hand, maps are also mutable and contested, leaving room for multiple voices and resistance. For example, Kwan (2007) explores the affective dimension of mapping. Drawing upon feminist approaches, Kwan (2007) illustrates how geospatial technologies can be used as "a medium of self-expression and a means of resistance, and to articulate emotional geographies and convey emotionally provocative messages" (p.25). In this way, geospatial technologies are more than representational media; they may constitute practices or performances that embody and express emotions and feelings. These studies provide important theoretical underpinnings in my framing of the CSM initiative and other crowd-sourced sound maps, as I will show later that the interface of the CSM, built using a Google Maps platform, is a form of VGI and should be interrogated as

part of visual practices influenced by social and technological conditions as well as actors involved.

Another important element of the visual practices involving VGI is its potential for public participation and civic engagement in the context of participatory mapping (e.g., Boulton, 2010; Elwood, 2010; Miller, 2006; Tulloch, 2008), with particular attention to the implications of the greater accessibility of Web-based mapping technologies and increasingly diverse, massive, and individualized mapping practices. For example, Miller (2006) discusses the use of Google Maps mashups in response to Hurricane Katrina and how these practices may constitute a user-centered GIS/2. Studies have also pointed out how VGI might perpetuate existing inequalities and create new forms of exclusion (e.g., Crampton, 2010; Crutcher and Zook, 2009). One example is the uneven contributions among VGI producers, reflecting the uneven geographies of cyberspace such as the long-tail effect in which a small number of contributors provide a disproportionally larger amount of content (e.g., Crampton, 2010).

There has also been discussion on the performative dimension of VGI and neogeographic practices (e.g., Crampton, 2009; Lin, 2013a). For example, drawing upon de Certeau's notion of tactics, Lin (2013a) traces how participants in an art performance project actively engage with neogeographic mapping to speak against the encroachment of urban public spaces in China. Such tactical spatial narratives are especially significant considering the information censorship and strong political control in China. In light of these studies, I will illustrate that in the case of CSM, some users have explicitly used this platform to project their voices speaking against social exclusion, while at the same time there are uneven patterns of contributions. Such a form of

resistance through sounds and speeches scattered or concentrated in certain places can be powerful, complementary to other forms of civic participation using mainly cartographic representation.

Another highly related area is research examining what kinds of knowledge politics are facilitated by these mapping practices (e.g., Elwood and Leszczynski, 2013). Elwood and Leszczynski (2013) investigate new forms of knowledge politics enabled by these new spatial media, the technical artefacts that enable and facilitate interactive online geographic information production and dissemination. They suggest that VGI initiatives facilitate 'experiential cartographic representation', which is helpful here to think about how the CSM might allow production of experiential knowledge through a combination of mapping and sounds facilitated by Web 2.0 technologies. Nonetheless, while there have been insightful analyses in critical GIS and participatory mapping addressing how various forms of representation such as videos and photos can be integrated into GIS and mapping (e.g., Cope and Elwood, 2009; Jung, 2009), little is discussed about the multi-modal dimension of VGI mapping that involves sounds. A more explicit discussion on the multi-modality of visual practices is still lacking, especially regarding the increasing involvement of multi-media representations in these practices. In this sense, the notion of viewing maps as 'visual practices' is further expanded to explicitly include other sensory experiences of exercising and experiencing mapping power, commingled with the visual experience. I suggest that insights from soundscape research are helpful in this regard with respect to exploring the intersection of auditory experience and mapping in sound maps, which are addressed next.

3. Mapping and experiencing soundscapes

Since R. Murray Schafer's pioneering work in the 1960s (Schafer, 1994), soundscape research has evolved into a multidisciplinary field (Raimbault and Dubois, 2005). The methods and ideas developed in Schafer's multidisciplinary approach on the relations between sounds and society have inspired a variety of fields including cultural history of sounds, qualitative research on sonic environment, and acoustic communication (Uimonen, 2008). Soundscape research seeks to understand how sounds, both from natural and human-made sources, "can be used to understand coupled natural-human dynamics across different spatial and temporal scales" (Pijanowski, Farina, Gage, Dumyahn, & Krause, 2011, p.1). In particular, recording and listening to various sounds is an important area of soundscape research (Kang, 2006).

One of the major goals of researching these practices is to engage with the notion of 'care for the sonic environment,' through 'listening with care' (Westerkamp, 2000), which may constitute "a tending to the soul that resides in nature as well as in human beings" (Moore, 1992, p.270). As such, this body of work draws upon acoustic ecology and seeks to improve the quality of the soundscape (Frayne, 2000). While this is an important area in soundscape research, I consider the strand of work that examines the social and cultural environment shaping our perceptions of sounds (Kang, 2006) more relevant to my study in this article. Particularly, I draw upon three perspectives from this strand of work. One is the efforts of mapping soundscapes. The second perspective is the discussion and practices of listening to landscapes, usually in an artistic context. The third one is to examine the production of soundscapes as a social and cultural practice. These three fields are related, pointing to the importance of examining the fluidity and hybridity of soundscapes and their relations with the environment and society.

Specifically, there have been notable efforts on the mapping of soundscapes. For example, through the project of developing a sound bite (chorography) database ChAOS, Balaÿ (2004) intends to use this database to help to "reconstitute the history of our contemporary sound environment" (p.13). Following on actions starting in 1992 and incorporating spatial information systems in these efforts in 1997, ChAOS was designed to "distinguish the way local people perceive sounds from the reactions of informed observers (acousticians, sociologists, architects and planners) carrying out field surveys" (ibid, p.14). To address this, the notion of perception of sound as time-based was emphasized, for which a temporal representation of sound signals was incorporated. This development is in contrast to the usually static representation of sound maps such as noise maps. Moreover, the database paid attention to the scope of making sound recordings in the neighborhood, which was seen as a medium for the neighborhood's sound memory. As such, this database can serve as "a starting point for imagining ways of reshaping the sound environment, proposing or correcting a particular acoustic space" (ibid, p.14).

In this way, this GIS facilitates new ways of exploring and organizing auditory journeys for the users. For example, the map shown on the computer can record the paths of the journey, in which sound recordings are also incorporated in the menu. The users may hear "the sound of steps on a staircase or in a garden, gaining access to a fragment of narrative depicting daily life in that particular place" (ibid, p.14). Moreover, the users can compile maps of their own that represent various topics. In other words, this database allows thematic mapping of various sounds as well as their interactions with the environment, in addition to possibilities of overlay analysis such as "summarising the built-up form of the streets, the type of ground surface, [and] the slope of the

thoroughfares" (ibid, p.14). This database is also connected with the Greater Lyon GIS. These efforts resonate with many public participation GIS constructions of incorporating and representing local knowledge in information systems in urban planning (e.g., Elwood, 2004; Ghose, 2005).

From a different perspective, Thompson (2004) traces and foregrounds the cultural meaning of noise and shows how sonic culture is inextricably linked with technological developments through the case of the American soundscape in the early 1900s. Thompson (2004) argues that "culture is much more than an interesting context in which to place technological accomplishments; it is inseparable from technology itself" (p.9). This discussion underpins the importance of investigating the production of sounds as a cultural practice, shaped by and embedded in a variety of conditions including technological constructions and in turn constitutes landscapes.

Meanwhile, there have been significant efforts to explore the possibilities of meaning making through sound. For example, drawing upon his Sonic Postcards from Istanbul project, Mermoz (2004) argues that sounds of the city assembled can open up new possibilities of meaning including narratives and readings about the city through an artistic context. This is in line with research underpinned by phenomenology (Revill 2014). For example, LaBelle (2010) engages with "the possibility of imaginative transformation" brought by sound (p.40). LaBelle (2010) suggests that sound "stimulates the imagination, and supplies constant input to individual experience" (p.83) and that "as a physical and spatial movement, sound carries a collection of information related to the conditions of the original objects or body, the source of sound, along

with the related environment" (p.200). Revill (2014) also provides important insights into exploring the 'sonic making of landscape' through conceptualizing 'landscape as mediation'. Using the soundwork *El tren fantasma* by Chris Watson, Revill (2014) illustrates the mediating role of sound, participating in "figuring landscape as historically and geographically specific auditory experience" (ibid, p.334). This field of research and practice underlines the role of listening and sound recording as a creative means to appreciate, stimulate, and construct narratives, memories, and reflections (Voegelin, 2006; 2014).

Shared in these perspectives discussed above is Michel Chion's argument that "sound is a cultural object constituted via an act of attention and naming" (cited in Mermoz, 2004, p. 23). In many respects, these conceptualizations of practices of hearing and listening resonate with the efforts in critical GIS and cartography of exploring and investigating geographic information production as visual practices. In this context, visual practices involve examining the visualization rendered by VGI and mapping as a hybrid way of 'seeing' and representation underpinned by certain assumptions and social relations (Elwood, 2011).

Drawing upon insights from research in critical GIS as well as soundscape research, I argue for an analytical framework to investigate CSM and other sound mappings at two levels. First, I investigate how sound mapping as VGI has emerged. Second, I explore how the contents of VGI sound mapping may constitute ways of appreciating and representing various environments and spaces. The first aspect is underpinned by research on deciphering soundscape and VGI as cultural practices influenced by broader social and technical conditions (Thompson, 2004; Elwood, Goodchild, and Sui, 2012). The second aspect is informed by works such as Revill (2014) and LaBelle (2010) that adopt phenomenology to understand "the experience of sound as

mediation in ways sensitive to both its embodied physical properties in perception and the socially and culturally situated practices of making sound, listening, hearing and reception" (Revill, 2014, p.336). With these two levels of analysis of the following empirical case, I contend that it is important to expand the notion of VGI to include multi-sensory experiences such as auditory experiences in sound mapping, which in turn have implications for landscape design and urban planning as I will highlight in the conclusion section. While I do not intend to reduce the rich sonic representations and auditory experiences to visual experiences here, I contend that exploring the multi-modality of visual practices is helpful to understand these mutual constitutions of multi-sensory experiences in particular space and time.

4. Methods and data

Interviewing and document analysis have been used in my study to understand the complexities of constructing and engaging with the CSM. Specifically, my analysis draws upon data collected since 2011 including an in-depth interview with one of the CSM founders conducted in July 2011. Other sources of data include documents such as online reports from mainstream newspapers and social media sites, journal articles and the like that are related to sound mapping. The majority of the documents collected were retrieved from the Internet. These online writings and discussions in my study 'took place' on various sites, including blogs and social networking sites. This approach of engaging with online materials is in line with what Marcus (1995, p. 96) calls "multi-sited ethnography," referring to approaches that examine the circulation of cultural meanings, objects, and identities in diffused time-space (see also Hine, 2009). It is worthwhile to note that when discussing my encounters with the sounds provided by the CSM, I do not seek to provide an interpretation of sounds that can be generalized to other people's experiences. The interpretation of these sound mapping practices is necessarily selected and limited, shaped by my

own background and position, a Han Chinese native who gained her postgraduate training in the United States and is currently working at a university in the United Kingdom. Being a Chinese allows the author to have easier access to possible research informants and materials revolved around the sound mapping website in this case, as the CSM and its predecessor the Harbin Sound Map have only Chinese interfaces.

Meanwhile, I am an 'outsider' to these sound mapping practices in many respects. When I first encountered the CSM site in my earlier efforts of collecting various VGI initiatives derived from China, the main 'coding' process of developing this site has already finished. In addition, my interpretations of sounds recorded in some places might be notably different from that of other users. Some recordings might involve different dialects that I may not understand. For example, in one recording, there is one term expressed in Shanghainese in its textual description, which became clearer to me after searching for its meaning. Yet, I by no means attempt to provide the 'most appropriate' interpretations of these sounds. Rather, I try to capture the major characteristics of these sounds in terms of types of contents based on what is being heard from these recordings as well their respective textual descriptions. Through this effort of providing an illustrative case, I aim to demonstrate the possibilities and challenges that these sound mappings might bring about regarding critical visualization. In so doing, a similar approach can be applied to examining and engaging with other sound mapping initiatives, for example, the Toronto Sound Map.

5. The CSM Project

In this case study, I investigate the practices revolved around the CSM at two levels underpinned by the theoretical framings noted above. First, I examine the ways in which data, code and technology help to construct these mapping practices such as spaces for the representation and display of the 'sounds' (Thompson, 2004; Elwood, Goodchild and Sui, 2012). Second, I discuss the CSM and associated practices through the content and context of the recordings, attempting to illustrate the range of sounds and how these sounds become alive on their own, transcending particular spatial and temporal contexts (Revill, 2014; LaBelle, 2010). Such an analysis is also informed by research in critical GIS that pays attention to the ways in which spatial knowledge is constructed as well as efforts in textual analysis and interpretations that intend to capture key characteristics of various representation and performances.

With respect to the first level of investigation, some of the contributors for the CSM might identify themselves as sound artists, who may constitute a community that also actively engages with sound artists in other countries (Yao, 2014). The design and development of the CSM are highly influenced by these Chinese sound artists and their sound art practices and performances, which seems to emphasize a dimension of personal appreciation and mediation of local environments and living conditions through sounds. While the number of sound map initiatives in the form of VGI in China may still be considerably small, the number of contributions that is greater than five hundred in the CSM project alone is nonetheless impressive. The former can be partly attributed to the relatively high technical complexities of setting up a sound map website for crowd-sourced initiatives. The latter can be attributed in large part to the increasing availability of sound recording devices including the use of smart phones.

I identify three categories derived from these crowd-sourced sound mapping practices: 1) recordings of the natural environment and everyday environment; 2) recordings of self-

narrations; and 3) recordings of explicit political statements and contestations. In many ways, interpretations of sounds in these categories displayed on the map show that "visuality is always multi-modal" (Merriman, Revill, Cresswell, Lorimer, Matless, Rose, & Wylie, 2008, p.201), as "visualities are always practiced and performed through a whole range of registers, one of which is the visual, but often that is accompanied by the auditory, the tactile, and so on" (ibid). I call for more attention to the multi-modality of visuality in sound mapping because the visual would usually be the first encounter for the map user in this context. Therefore, the visual would serve as a major anchor or entry point, and yet it is inextricably linked with the auditory experiences. While this notion may privilege the visual over the auditory and the user may choose to play the recordings randomly from an existing playlist on the map, I hope that emphasizing the multi-modality of visuality helps to provide an opening for inviting more active engagement with experiences from these two senses in mappings, which otherwise could be dominated by the visual. While it is possible that one may encounter various soundscapes without a mapping interface, I will show through the CSM case that this notion helps to highlight rich possibilities of engaging with embodied experiences brought by sound mapping. I further elaborate on these two levels of analysis in the following two subsections.

5.1. The making of the CSM project

The CSM was first set up in 2009, of which its predecessor was the Harbin Sound Map (HSM hereafter). Liu (pseudonym), a sound artist, was one of the founders of both maps. The sound map idea was partly derived from a blog maintained by Liu's friends who were photographers. This blog attempted to record "impressions" of Harbin city through photos (personal communication, July 30, 2011). Liu noted that there were some attempts of creating online sound maps in Europe in 2007, while there were no similar efforts in China at the time (personal

communication, July 30, 2011; see also Changhe, 2009). This notification from Liu suggests that the HSM and CSM are not stand alone cases emerging from China, but are more or less also influenced by practices elsewhere. Liu and his friends who shared similar interests subsequently rented a server to start the HSM (Figure 1). In this map, the uploaded sound clip was posted on the location where it was recorded. Once the users register for the map, they would be able to upload the recordings themselves, which would then be converted to a uniform format such as mp3 in the server to be displayed and played on the website (personal communication, July 30, 2011).

The technical developments of the HSM have been largely carried out by Liu. While Liu had some coding experiences related to his work, the programming environment using Google Maps was new to him. Liu learned by himself how to use relevant Application Programming Interfaces (API) from Google Maps. The HSM was built using Google Ditu (the Chinese version of Google Maps) API, ASP and Access. Yet, he encountered some unexpected challenges in this process. There were mismatches between the map layer and the satellite layer in Google Ditu, which caused problems for the HSM. There were no solutions readily available elsewhere. Liu spent tremendous efforts through searching, consulting, and numerous experiments before he eventually resolved this issue (personal communication, July 30, 2011; see also Changhe, 2009). When this HSM model was expanded to a much larger scale for the CSM, PHP was used. Liu only had very limited experiences using PHP years ago before this CSM project. It was his strong interest in this project that propelled him to learn to use PHP and keep revising the code until it worked (personal communication, July 30, 2011).

Regarding the effect of the HSM, Liu noted that previously, many people might be only familiar with a limited number of places in the city. With the HSM, this scale of representation of smaller areas and particular points can be very refreshing, and it may bring about some reflections on our existence in the city (personal communication, July 30, 2011; see also Changhe 2009). In another interview Liu had with a blogger from a website on Harbin, Liu also hoped that both the HSM and CSM would help people pay more attention to listening and hearing and sharpening their aural awareness (Changhe, 2009). At the time of writing, this HSM has 65 recordings, mainly contributed by the members from the same group that initiated the HSM. One factor of this relatively small number of recordings in the HSM compared to that of the CSM is that Harbin may not have a strong cultural industry as Beijing or Shanghai; therefore, there were not many participants (personal communication, July 30, 2011). However, this map had drawn some attention from local press, including a report by *Harbin News* in 2009. This acknowledgment of the relatively marginalized position of Harbin is interesting, reflecting how broader social and political conditions might influence the level and extent of sound mapping practices, which are clearly cultural practices as recognized by Liu. On the other hand, how these sound mapping practices were first established in a city with relatively smaller cultural capital than other big cities indicates the important role of agency in experimenting with and cultivating these practices.

Building upon the HSM model, the CSM was initiated in 2009. Another friend of Liu, who was also a sound artist and lived in Hangzhou, was able to obtain a fund from JNBY Ltd. Art Center to support and expand this project to a national scale (Figure 2). With this fund, they were able to purchase a server; although currently this fund has ended, the CSM is still open for new

registration and uploads. The CSM, according to Liu, was mainly promoted through two channels: one is through blogging by his friends while the other is through posting on social media platforms such as Douban (www.douban.com). Douban is a popular social media site founded in 2005 with an initial focus on sharing information about books, movies, and music. One of the characteristic features of Douban is its interest groups, consisting of members of similar interest on particular topics. The CSM has its interest group on Douban, whose membership grew from two hundred and twenty one on November 28th 2011 to three hundred and ninety one on August 25th 2014. This shows a growing interest on the CSM, although the project has passed its 'official stage of construction' as the funding support has stopped by July 2011 when my interview with Liu took place. On the Douban page of this interest group, members not only discuss their experiences of field recording related to the CSM, but also share information about related news and practices, such as the most recent post (on August 21st 2014) on recruiting participants for the 'Growing up with Shanghai' project. It is clear that the emergence and growth of the CSM has been significantly influenced by the Web 2.0 technologies such as the coding component and mapping platform illustrated earlier. Also, virtual communities such as the Douban interest group plays a role in constructing and engaging with the CSM.

Overall, while setting up a sound map like the CSM is a demanding task for those without coding experiences, the level of technological barriers for users to provide contributions to and interact with the platform is generally low. A link to a help page is available on the top right side of the CSM interface. This help page notes that the users only need to take two steps to publish their sounds on the map, with screenshots provided for both steps. The first step would be to upload

the sound file after logging in. There is a size limit of 100 megabytes for the data, and the format of '128kbs mp3' is recommended. The subsequent second step is to click a location for the recording and fill out four fields in the form (recorder's name, recording time, recording location, and recording description) before the recording is published.

At the time of writing, there are around five hundred and seventy recordings posted within China. In these recordings, there is a peak of recordings in 2009 with around one hundred and eighty clips according to their notes of the recording time, followed by the year of 2012 with around one hundred and forty clips (Figure 3). Yet, because this map was built in 2009, these recordings that took place prior to this (e.g., in 2004) would only be uploaded after the development of this map, possibly reflecting long-term practices of sound recording that are mostly likely carried out by sound artists. Figures shown in Figure 3 also indicate that this map is still actively used by many users since its inception. There are two hundred and thirty names of various recorders shown on the map. However, contributions from these participants are uneven, showing a long-tail effect (Crampton, 2010). In particular, around five percent of the contributors (calculated based on the names of recorders) who have contributed approximately forty seven percent of the recordings posted. Figure 4 depicts the distribution of the contribution percentage of these accounts in this regard. Nonetheless, this number of contributors is quite large and it may continue to increase in the future.

In the process of building and using the CSM, there are a few characteristics worth emphasizing. First, the CSM is without doubt shaped by the experiences of its founders and their active engagement with sound art activities as well as other artistic performances. Second, in some

respects, the CSM has achieved a rather significant level of crowd-sourced contributions, compared to other VGI initiatives in China (e.g., Lin, 2013a), although one needs to be careful that given the different purposes and contexts of each VGI initiative, it is not necessarily the larger number of participants the more significant the VGI initiative might be. Both the commitment from the founders and the online community such as the Douban interest group have a role. Third, the geographies of these contributions shown on the map are uneven. Generally, the coastal regions have more contributions, resonating with the uneven development in China. These characteristics and factors, on the other hand, intersect with one another, shaped by the socioeconomic and political conditions in China with its rapid urbanization and globalization processes underway and strong political control in place simultaneously, while also showing possible cracks for new ways and channels in which people, sound artists and non-artists alike, engage with their everyday sound environments, memories, and contestations against dominant discourses.

These sounds, displayed on the CSM, also allow an outsider an opportunity to engage with these sounds through hearing, listening, and visualizing. These recordings seem to have a snapshot of particular place and time, but the stories and information embedded in these sounds may transcend beyond that particular moment and place, constituting and figuring landscapes for the listener (Revill, 2014). I argue that these forms of experiences constituted through such sound mapping practices are an important component of spatial knowledge production, which is further explored in the next subsection.

5.2. Hearing, listening, and speaking through the CSM

While topics of narrations vary three broad categories are notable from my experience of listening to these recordings. Given the ongoing efforts of CSM contributions and the diverse range of topics and sounds already recorded, I do not attempt to suggest that these three categories would be comprehensive. Rather, I see these recordings as a fertile ground for identifying some recurring themes and messages with respect to encountering the daily life and everyday environment, while also being sensitive to the uniqueness and distinction each recording may exhibit. In addition, these categories may not be mutually exclusive, as some recordings may belong to more than one category.

5.2.1. Recording acoustic environments

Specifically, one category is characterized by recording external environments and everyday encounters. This category is perhaps the closest type to those described in the soundscape research such as field recordings with a concern of the awareness of acoustic surroundings (Pijanowski, Farina, Gage, Dumyahn, & Krause, 2011). Here the recordings might be sounds of ecological environments such as birds and rain. They also might be everyday encounters, such as sounds of traffic, construction, music played in stores, vending machines, random conversations, discussions in parks, kids playing, etc. These sounds may seem fragmented. Yet, they constitute various soundscapes within particular time and space.

In one example, there is a recording of the music from a café known for its Jazz music in Beijing. The recorder acknowledged in the field of recording description: "The first song on the evening of April 1st, very nice sounds from the piano and the harmonica". This café is among many other pubs and cafés that started to reside in this region in central Beijing famous for its

hutongs (alleyways), constituting the so-called 'Shishahai Bar Street'. The bar street has become more well known since last decade, and it has been a phenomenal tourist attraction, while it is not without criticisms including concerns about the noisy environments brought to local residents. This café might be considered as one of those quieter places. The music in this recording resonates with that image, constituting a calm environment.

There is another recording by a different recorder that addresses the 'noisy' part of the area. The recording is located near the Lotus Market, several hundred meters south of the café noted above. This clip plays a section of a song of a particular style that might derive from areas close to Hangzhou and Shanghai, as Hangzhou was mentioned in the song. It was accompanied by a traditional Chinese musical instrument. The description is as follows: "The pubs here are really noisy. Singers sitting in the terraced cages, and their songs are a string of noises. Each one is stronger than Torturing Nurse. And these people who are trying to get guests into their pubs, how annoying you are. S*** [in Shanghainese]. Only this uncle sings well!" One may not need to know about Torturing Nurse, a harsh noise group based in Shanghai, or the phrase expressed in Shanghainese to understand the dislike of the 'nosy bars' from this recorder. Such a dislike might be shared by others, which might be utilized as part of the reasons to transform this region by the local government (Chinese Business Journal, 2013).

In some cases, these sounds may help to capture and document the changes of the landscape over time. For example, Liu described that he tried to record some sounds north of Songhua River in Harbin. He recalled that it was very quiet at that time and that what was captured was the sound of dog barking. However, what one might hear mostly there now is the sound of traffic, as there

have been many buildings constructed since then (personal communication, July 30, 2011). In this regard, soundscapes can be "an indicator of social and environmental change" (Wagstaff, 2000, p.19). While Wagstaff (2000) suggests that the causal processes behind such changes can be potentially examined through soundscapes, Liu seems not focus on revealing such relations through his work. Liu notes that these sounds from the CSM are open for interpretation and that one may feel that spaces are mutable and movable in these sounds (personal communication, July 30, 2011). As such, noise might be heard differently, and it can be meaningful and even 'beautiful' in some cases (ibid). Such an approach resonates with Revill's (2014) notion of landscape as mediation and "a conception of sound as simultaneously medium and message" (ibid, p.336). This way of approaching these sounds by Liu may in turn influence what we might hear from the CSM contributions from other participants who might hold a similar view. These recordings may invite new meaning-making by the listener when she approaches these recordings (Voegelin, 2014), as she argues, "the soundscape offers an alternative perspective on the landscape, producing new ideas on how it could be and how we could live in it as in a sonic world, and how therefore we could validate the reality of sound's invisible formlessness in relation to the visible and formed actuality of the world" (ibid, p.10).

While not all of these recordings in this category are intentionally produced as sound art work as illustrated by Mermoz (2004), in many ways, these sounds extract certain layers of the everyday fabric, and once recorded and shared, they become both local and global. On the other hand, the ambiguity of these sounds further invites future research on explicating the entangled relationship between the recorder and the listener, the mapper and the map user. One example is that the sounds of urban traffic are not an uncommon theme in this map. Is this also the case in

other sound maps of the city? How might we approach this theme, as a rhythm of the city life (e.g., Revill, 2013), an indicator of noise and sound pollution (e.g., Kang, 2006), or something mainly aesthetic? Or all of the above?

5.2.2. Recording self-narrations

A second category centers more on self-narrations and diary-making, which can be ranged from one's own narrations to recording sounds from a moment of traveling, walking, standing, or singing. These may also include recordings to address particular occasions, ranging from birthday wishes to wedding ceremonies. There is one recording about a conversation seemingly derived from a student organization of Hubei University. The comment goes:

> Not sure what the feelings might be when we hear this again a year later. […] We feel so happy now. Will come over here to listen to it again when we get old, for which we can remember these happy times.

This recording acts like a diary, capturing 'these happy times'. Yet, new layers of emotions might be triggered and generated when the recording is listened to again later. These practices of recording these everyday moments in a diary-making manner speak to what Dodge and Kitchin (2007) note as a form of 'digital self', emerged as part of constructing a personal multimedia archive. These shared on the map may be special moments for the authors and participants involved. Furthermore, these practices blur the line between 'writing' and 'listening/hearing', for which many studies have attempted to highlight the importance of using listening and hearing as another form of knowledge production (Erlmann, 2004). 'Writing', and by extension, visualization, usually invokes objectivity and a distance between the observer and observed.

Particularly with respect to the focus of this article, while numerous studies have critiqued such a positioning of 'visualization' including work in critical GIS and cartography which has revealed the unstable, selective, and always in-the-making process of mappings (e.g., Crampton, 2009), the sense of hearing has not been given much attention. As such, I view such an intersection as examples illustrating the multi-modality of visuality (Merriman, Revill, Cresswell, Lorimer, Matless, Rose, & Wylie, 2008), in which these recordings form "spatially situated histories and memory" (Mitchell and Elwood, 2013, p.35).

These narrations, often expressed in a confessional way, may also serve as what Voegelin (2006) calls 'sonic memory material'. Voegelin (2006) discusses the notion of sonic memory as "the multitude of memories that the listeners bring to the work which trigger and are actualised by this contingent process of perception and which continually develop the interpretation and judgement of the work" (p.17). While Voegelin (2006) has illustrated this notion through the discussion on artwork, I would like to press a step further to incorporate these narrations that may not readily fall within the category of artwork in official discourses.

Another example is a case of posting birthday wishes by the ID 'Wanwan' that has generated warm feelings expressed in a thread started in 2011 on the Douban page of the CSM interest group (http://www.douban.com/group/topic/18205227/). The time for these recordings by 'Wanwan' was October 27, 2009. There were a few recordings by the same ID in Beijing, Shanghai, Hangzhou, and Dalian. In these recordings, she expressed her birthday wishes to her loved one while also recalled briefly the journeys and experiences they had together in these places. One post responding to these recordings in this thread on Douban in 2012 notes, "I

listened to this several times this afternoon, and I was almost moved to tears." Another one wrote, "A very warm voice." Still another mentioned, "I don't know this person." The narrator in the recordings may or may not expect her voice would touch other people. Not everyone would have the same emotional response to this recording. One may also neglect these sounds that seem to be too personal, trivial, and banal. Yet, this platform of the CSM, along with other platforms such as Douban, provides an opportunity to hear, listen to, interact with, and imagine about these small stories including the places involved, which may have some hidden power of touching the listener and triggering sonic memories of particular places and moments.

These memories and imaginations revolved around these narrations can be seen as another manifestation of experiential knowledge (Elwood and Leszczynski, 2013). Further research is needed to provide more in-depth discussion on how these might play a role in subjectivity formation and identity construction in the Web 2.0 age. For example, how might the affective dimension of hearing and seeing play out in these visualized auditory narrations (e.g., Kwan, 2007)?

5.2.3. Recording political statements

A third category would consist of sounds derived from more explicit political efforts. They may be narrated through personal voices. In particular, there was an event organized by the 'Wuhan Rainbow' organization according to the recording description, entitled "Spreading love through sound mapping on May 17th International Day Against Homophobia and Transphobia." Approximately twenty recordings were posted. In each of these recordings, the author would make a brief statement, share one's own story, or show support for this event. While this event

was initiated by an organization based in Wuhan city, there were recordings posted in other cities across China such as Chongqing, Daqing, Jinan, and Nanchang. One speaker noted at the end of her recording that "like what was said in an advertisement, one small step for a person, one big step for the society." At the time of writing, this is the only event with an explicit political statement represented in the CSM. While twenty is not a large number and it constitutes approximately three percent of the recordings shown in China, this is worth further discussion as it might suggest another potential of civic engagement through VGI. This type of political engagement resonates with a politics of 'tactical spatial narratives' (Lin, 2013a), in which participants utilize special moments to carve out spaces of resistance and contestation. This may also indicate a particular form of networked publics (Lin, 2013b).

At this stage, it is difficult to assess fully the impact of these recordings of explicit political statements. However, such recordings on the CSM might have reached new audiences over time and gained a level of additional visibility. The power of oral narration for a political act has been tapped into in these efforts. Such a placing of these recordings can enable an effect of a stronger voice speaking through the CSM, indicative of a possibility "of re-inscription and gentle politics as well as purposive resistance" (Crouch, 2010, p.13). Further research can be conducted to investigate how this form of civic engagement might resonate with or differ from the emerging knowledge politics that is characterized by "a prioritisation of individualised interactive/exploratory ways of knowing" (Elwood and Leszczynski, 2013, p.544).

Together, these different types of sound recordings shown on the CSM provide a repertoire of emotions, memories, and stories embedded in particular places and moments (e.g., Kwan, 2007;

Mitchell and Elwood, 2013). The efforts of the CSM founders resonate with those of Balaÿ (2004) and Mermoz (2004) discussed earlier along two dimensions. One is to engage with a participatory database development to incorporate local residents' perceptions of sound, which in turn constitute local environment, following the rich tradition of PPGIS (e.g., Sieber 2006). The second one is to explore the capacity of sound to "mediate between self and self, self and others, people and places" (Mermoz, 2004, p.23; see also LaBelle, 2010; Revill, 2014). Such mediation is entangled with visuality afforded by the map, constituting the multi-modality of visuality in the case of sound mappings, which in turn would help to "deepen an articulation of landscape in relation to life, and space in relation to living" (Crouch, 2010, p.7).

6. Conclusion

The crowd-sourced contributions of the CSM, one major entry point of my article here, provide a rich opportunity to probe the question about exploring the entanglement of the auditory and the visual (e.g., Mason and Davies, 2009) concerning VGI practices (e.g., Elwood, Goodchild, & Sui, 2012). One might compare these sound mapping practices emerged in a shared mapping platform like the CSM project with the visualizations in Google Earth and mashups created via Google Maps. A possible convergence of these two modes of mapping is the practice of layered data (visual or sonic), facilitated by Web 2.0 technologies. This layered information may well be very personal, and yet shared by many and helps to constitute a multifaceted sense of place. In their analysis of the phenomenon of the emergence of VGI, especially the growth of mashups that are used to integrate multiple sources of data linked to a shared spatial reference, Elwood, Goodchild and Sui (2012) argue that the overlay enabled through mashups "is revitalizing an interest in synthesis in GIS" (p. 582). They view mashup as both a concept and practice, which

"resonates well with the traditional spirit of geography in its quest to understand the multidimensional nature of the Earth's surface" (ibid, p.582). I extend that further to argue that the integration of sounds into a map, produced through multiple user-generated contributions, may add another dimension of understanding the physical and social spaces that are also increasingly embedded and recreated in digital spaces. Such an extension is in line with research such as LaBelle (2010) stressing that sound "provides a key relational means for registering social contact and feelings for place" (p.54). These sounds and stories embedded in these clips may not be quantifiable following traditional spatial analysis approaches in GIS. Yet, these recordings constitute another layer of locational information that may produce meanings extending well beyond the particular locations they are embedded.

Drawing upon insights from two largely separated fields, VGI research and soundscape study, I have investigated a case study situated in China to understand in what ways the mapping and the hearing might merge and mutually constitute one another. I have shown two levels of possible engagement with the CSM and other related sound mapping practices. At one level, I have revealed the social and technological conditions through which VGI and the CSM have emerged, informed by research such as Thompson (2014) and Elwood, Goodchild, and Sui (2012). At another level, I have explored and foregrounded the possibilities as well as challenges of encountering, hearing, and interpreting the sounds mapped, informed by a phenomenological approach such as Revill (2012). In so doing, I contend that such mappings underpin the notion of multi-modality of visuality (Degen, DeSilvey, & Rose, 2008; Merriman, Revill, Cresswell, Lorimer, Matless, Rose, & Wylie, 2008).

Specifically, I have illustrated the context in which CSM has emerged, which resonates with the processes of many VGI initiatives (Goodchild, 2007; Elwood, Goodchild, & Sui, 2012). These processes are characterized by the increasing engagement with Web 2.0 technologies and mobile devices from a wider range of participants resulting in explosive growth of digital data. However, the emergence of sound maps is worth further investigation regarding the role of auditory experiences in relation to digital mapping and spatial narratives. In the case of the CSM, it has been influenced by the vision of its founders who are sound artists and seem to adopt a phenomenological approach to sound. The construction of the CSM exhibits path dependency technologically as well, following an earlier attempt of developing the HSM in Harbin. Online communities revolve around particular topics or interests also play a role, such as the postings of the CSM interest group on Douban show.

Furthermore, I have identified three broad categories of sound mapping practices emerged from the CSM initiative: 1) sounds from external environments and everyday encounters; 2) self-narrations and storytelling; and 3) more explicit political statements. These are not meant to be an exhaustive typology of the sound mapping practices. However, these three categories underline different and related questions that can be examined further regarding the multiple modalities of visuality. The first category overlaps greatly with much research in soundscape study that has a rich tradition in examining the production of sounds as a complex cultural landscape (e.g., Smith, 2004). We may ask how these recordings help to create certain spatial-temporal imaginations in the context of sound mapping. The second category may provide new questions and insights regarding the ongoing discussions in geography and related disciplines on mapping and memory (e.g., Mitchell and Elwood, 2013), as well as the discussion on sonic

memory (e.g., Voegelin, 2006). The third category, by making these political voices heard and visible, can potentially enrich debates and conceptualizations of civic engagement and public participation in the Web 2.0 age (e.g., Elwood and Leszczynski, 2013). In particular, in the case of China with strong political control, such VGI practices can provide alternative spaces for political contestations and resistance (Lin, 2013a). With the diverse, and possibly growing, topics of sound mapping records available through the CSM and other initiatives, continuous efforts are needed to investigate these practices further.

While limited in its scope, I argue that this study and future research built upon this can help to provide complementary knowledge about issues related to landscape planning, design or management. The call for more attention to the multi-modality of visuality implies that landscape design might need to pay more attention to the sound environment. For example, Chow and de Kloet (2013) argue for including the audio with the visual when engaging with the landscape. They present a discussion on the Hong Kong Coliseum, a venue for pop music performance, serves as an emotive landmark for Hong Kong citizens.

Related to this, my study also seeks to illustrate the possibility of new meaning making through sound mapping, resonating with a growing body of work going beyond the sonic materiality regarding the effects of sounds on communities (e.g., LaBelle, 2010; Revill, 2014). In this way, a sound map constructed in a manner of VGI can help further illustrate and reveal what kinds of sound might be meaningful to the recorder/narrator and how they might be received by other users. The crowd-sourced contributions can potentially complement GIS databases developed by experts and professionals for landscape design or urban planning (e.g., Balaÿ, 2004). Such

knowledge production may take the form of the so-called 'facilitated VGI' (Cinnamon and Schuurman, 2013). In addition, paying attention to the intersection of the auditory and the visual shown through such sound maps is in line with Voegelin's (2014) call to listening to the soundscape as "one slice of the landscape" and to explore it "in the complexity of its circumstance, to illuminate its reality and how it participates in the construction of an accepted actuality" (p.11). More research is needed to further investigate sound mapping practices in different contexts and their associated sociopolitical implications.

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